higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

MECHATRONIC SYSTEMS
NQF LEVEL 2

(6040102)

2 December 2020 (X-paper)
09:00–12:00

This question paper consists of 6 pages.

213Q1N2002

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TIME: 3 HOURS
MARKS: 100

INSTRUCTIONS AND INFORMATION

1. Answer all the questions.
2. Read all the questions carefully.
3. Number the answers according to the numbering system used in this question paper.
4. Sketches must be large and neat.
5. Use fully labelled IEC symbols.
6. Write neatly and legibly.

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QUESTION 1

1.1 Study FIGURE 1 of a simple conveyor belt system used in a mechatronic transfer application.

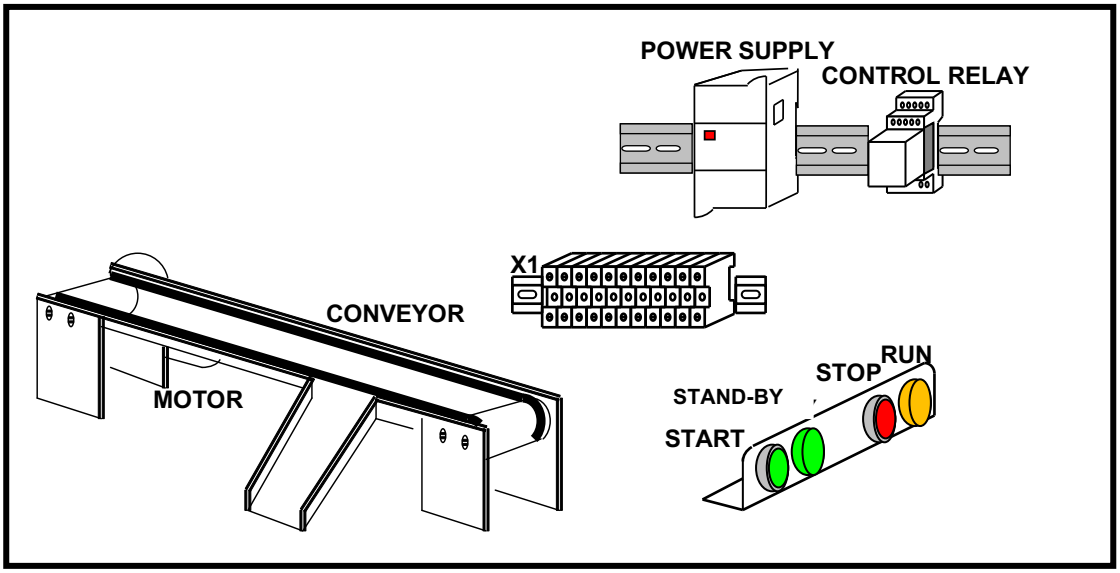


FIGURE 1

1.1.1 What type of diagram is shown in FIGURE 1? (1)

1.1.2 How does a pictorial diagram assist you in designing a mechatronic system? (5)

1.1.3 Why is it important to analyse the operation and general make-up of a mechatronic system? (2)

1.2 Draw a mechatronic system diagram that would represent the conveyor transfer system depicted in FIGURE 1. (8)

1.3 Draw the INPUT-PROCESS-OUTPUT single-block technical diagram that will represent the DC-geared motor. (4)
[20]

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QUESTION 2

Study the two control circuits A and B shown in FIGURE 2.

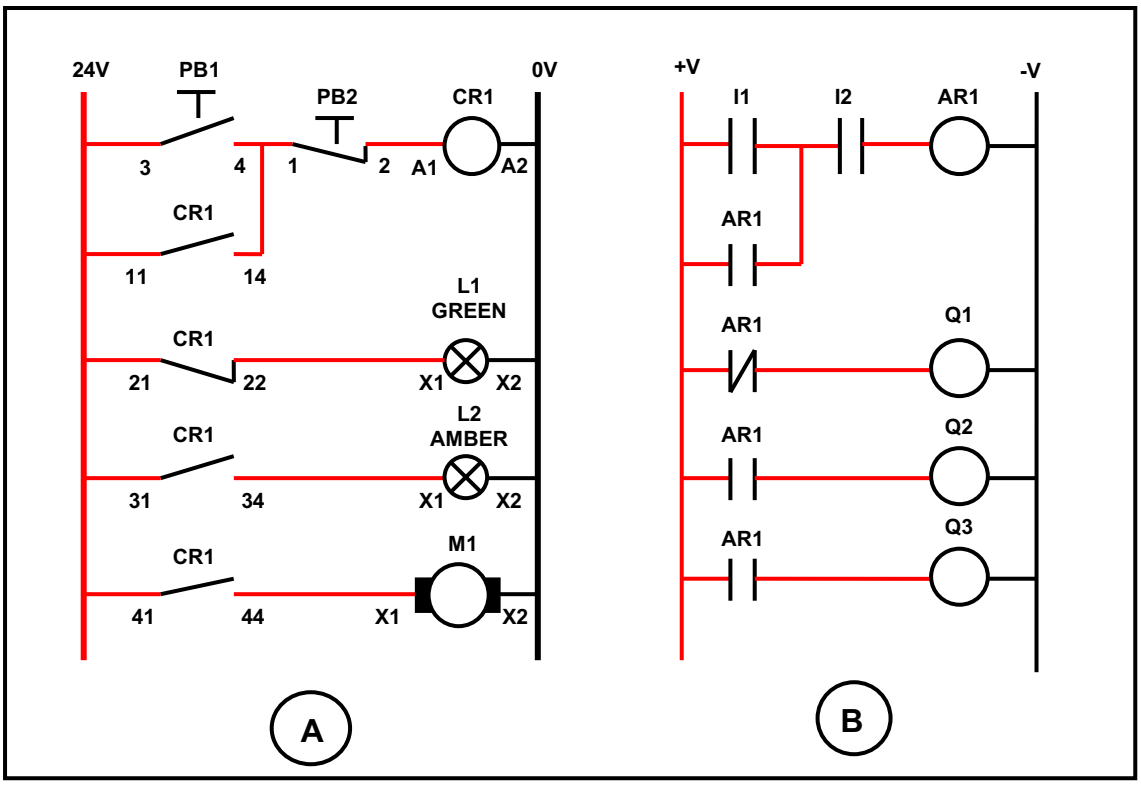


FIGURE 2

2.1 What type of diagram is shown by control circuit A? (1)

2.2 What type of diagram is shown by control circuit B? (1)

2.3 What enables you to distinguish between circuits A and B? (2)

2.4 Explain the operation of circuit A. (4)

2.5 Answer the questions below about FIGURE 2, circuit A.

Give the full description of each of the following that would be written on an order form or materials list:

2.5.1 What type of push button is PB1?

2.5.2 What type of push button is PB2?

2.5.3 What type of lamp is L1?

2.5.4 What relay is CR1?

2.5.5 What type of lamp is L2?

2.5.6 What type of motor is M1?

(6 × 2) (12)

[20]

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QUESTION 3

The soft-drink can crusher shown in FIGURE 3 is used to make the transport of the cans easier. It is manually operated using pneumatics to do the work.

The system operates as follows:

- The system is manually operated.
- Pneumatic cylinder A1 weakens the can from the side.
- Pneumatic cylinder A2 compresses the can from the top.
- Pneumatic cylinder A3 ejects the crushed can from the crusher machine.

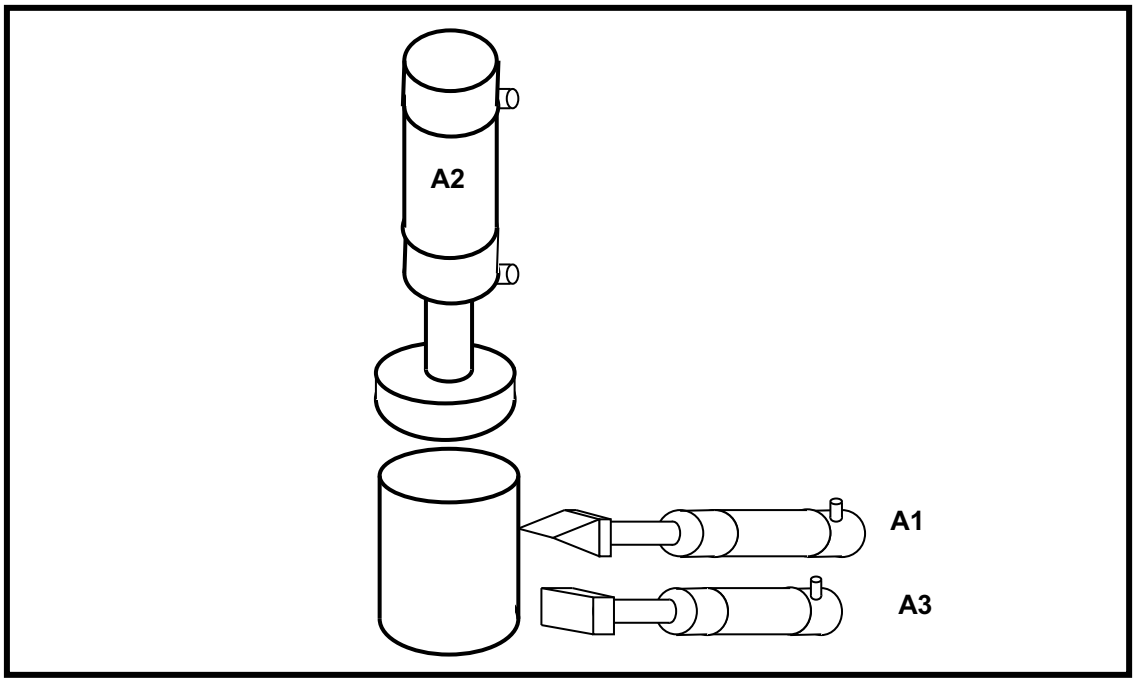


FIGURE 3

3.1 Name the type of pneumatic cylinder represent by A2 in FIGURE 3. (1)

3.2 Draw the IEC symbol of the cylinder represented by A2 in FIGURE 3. (2)

3.3 What type of pneumatic cylinder is represented by A1 and A3 in FIGURE 3? (1)

3.4 Draw the IEC symbol of the cylinder represented by A1 and A3 in FIGURE 3. (2)

3.5 Explain the purpose of using a status displacement step diagram in the design or fault-finding process of a pneumatic application. (2)

3.6 Draw the status step diagram representing the task process represented by the three cylinders in FIGURE 3. (10)

3.7 What pneumatic device would you use to detect the position of the three cylinders used in the task shown in FIGURE 3? (2)

[20]

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QUESTION 4

4.1 What energy type is used in the control circuit of an electropneumatic application? (1)

4.2 Why is the energy type mentioned in QUESTION 4.1 used for control of electropneumatic applications? (2)

4.3 Explain how the link between the electrical control circuit and the pneumatic working circuit is achieved. (2 × 2) (4)

4.4 Draw a electropneumatic control circuit using fully labelled IEC symbols to meet the requirements of the task outcomes of FIGURE 3 and the status step diagram developed in QUESTION 3.6, using push buttons, solenoid valves, sensors and cascaded timers. (8)

4.5 State the safe DC voltage that would be used in a pneumatic control circuit. (1)

4.6 Make simple drawings and explain the difference between *delay-on timers* and *delay-off timers* used in electro-pneumatic control circuits. (2 × 2) (4)
[20]

QUESTION 5

FIGURE 2, circuit A in QUESTION 2 is the circuit of a motor start/stop control circuit commissioned in 2017. The circuit has become faulty and the output/input through the circuit approach has been recommended to troubleshoot this control circuit.

5.1 What would be tested first using the recommended approach, when the motor fails to start? (2)

5.2 What should be done if the motor (M1) is found to have a supply voltage present? (2)

5.3 What should be done if it is found that the motor does not have a supply present on its terminal but the amber run lamp (L2) is illuminated? (2)

5.4 What should be done if there is no supply found on contact 4.4? (2)

5.5 What should be done if there was a supply found on contact 4.4 and it has been established that there is continuity on the negative side of the motor (M1)? (2)

5.6 Make a simplified drawing and explain how a buzzer should be used on a dead circuit to check the continuity between contact 3.4 of CR1 and the terminal X1 of lamp 2. (4)

5.7 State SIX skills a mechatronic technician should have to troubleshoot a mechatronic system. (6)
[20]

TOTAL: 100

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